Hydrologic Model Manager

Short Name	DAFLOW
Long Name	Diffusion Analogy Flow Model
Description	
Model Type	The DAFLOW model is a continuous model of flow in a network of one-dimensional open channels.
Model Objectives	The model provides a time series of discharge, flow area, top width, and tributary inflow at node points along a system of one-dimensional open channels. The time series of hydraulic variables can be used as input hydraulics by a transport model, such as the BLTM water quality model. The model is designed to operate with a minimum of field data. It requires no cross sectional information, the channel properties being defined by hydraulic geometry coefficients which have been found to be fairly predictable for a wide range of river sizes throughout the world. The flow must be unidirectional and backwater must not be significant, so a downstream boundary condition is not required. Model accuracy improves with river slope and model time step size. The accuracy is excellent for upland streams and it can be used can be used with good accuracy for time steps as short as one hour as long as the slope is greater than 0.0003.
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Model Structure	The model solves the diffusion-wave form of the momentum equation. It is, therefore, extremely stable but accuracy degrades as the channel slope and time step size approach zero. The model has been coupled to the USGS MODFLOW groundwater model. The model has been developed for upland streams where flow in unidirectional and backwater is not significant. As a rule of thumb, the following table gives the approximate minimum slope that should be simulated by DAFLOW for various time steps. Time step Minimum Slope 5 minute 10 ft/mile; 0.002 1 hour 1.5 ft/mile; 0.0003 6 hour 0.25 ft/mile; 0.00005 12 hour 0.1 ft/mile; 0.00002 The model has been used for streams of all sizes ranging from the lower Mississippi to small laboratory flows a few centimeters deep.
Interception	
Groundwater	
Snowmelt	
Precipitation	
Evapo-transpiration	
Infiltration	

Model Paramters	The channel properties, which are defined for each subreach between node points, include the channel slope and the hydraulic geometry coefficients and exponents for area and width. The hydraulic geometry exponents have been found to remain relatively constant for a given river system and even among rivers. The hydraulic geometry coefficients can be estimated from channel resistance (Mannings n) or from the speed of flow waves traversing the system.
Spatial Scale	The river system is represented by a series of branches connected by junctions. Any number of branches may be connected to a junction. Flow must be unidirectional and if more than one branch receives flow from a junction, the percentage of junction flow to enter each branch must be specified. Branches are subdivided into subreaches that are separated by nodes.
Temporal Scale	The model can be run for any time step ranging from monthly to 0.01 hour. Model accuracy improves with increasing time step. Resolution of course, decreases as the time step increases.
Input Requirements	The model requires a time series of the inflow at the upstream end of each external branch and tributary inflow that may occur at each interior node.
Computer Requirements	DAFLOW operates under DOS on any 286, or better, machine. Depending on the application, only 640K of memory and 1.5mb of disk space are required.
Model Output	The DAFLOW produces discharge output at user specified node points and time intervals.
Parameter Estimatn Model Calibrtn	Hydraulic geometry parameters can be estimated externally, from flow resistance or wave speeds. They may also be determined by use of an optimization routine such that the model results most nearly fit observed discharges at individual sites.
Model Testing Verification	DAFLOW has been tested and used on numerous projects both within and outside of the USGS.
Model Sensitivity	The most important parameter for calibration is the hydraulic geometry coefficient for area (A1), which controls the wave speed at a specific discharge, the timing of the computed hydrograph. Generally the second most important parameter for calibration is the hydraulic geometry exponent for area (A2), that controls the change of wave speed with discharge. The rate of attenuation of the flow peaks is primarily influenced by the hydraulic geometry coefficient for width (W1). The hydraulic geometry exponent for width (W2) controls the change in attenuation with discharge and is often of little consequence, especially for steep channels.
Model Reliabiity	Model stability and repeatability are excellent. Accuracy decreases with decreasing slope and time step size.
Model Application	The following are references to reports that describe projects that have used the DAFLOW model. Dorava, J.M., and Meyer, D.F., 1994, Hydrologic hazards in the lower Drift River basin associated with the 1989-1990 eruptions of Redoubt Volcano, Alaska, in Miller, T.P. and Chouet, B.A., eds., The 1989-1990 eruptions of Redoubt Volcano, Alaska: Journal of Volcanology and Geothermal Research, Special Issue, v. 62, no. 1-4, p. 387-407. Graf, Julia Badal, 1995, Measured and predicted velocity and longitudinal dispersion at steady and unsteady flow, Colorado River, Glen Canyon Dam to Lake Mead: Water Resources Bulletin, American Water Resources Association, Vol. 31, No. 2, April, P. 265-281. Laenen, Antonius, and John C. Risley, 1997, Precipitation-Runoff and Streamflow-Routing Models for the Willamette River Basin: Oregon, U.S. Geological Survey Water-Resources Investigations, Report 95-4284, 197 pages. Myers, Donna N., Greg F. Koltun, and Donna S. Francy, 1998?, Hydrologic and biologic factors affecting fecal-indicator bacteria discharge in the Cuyahoga River and implications for management of recreational waters, Summit and Cuyahoga Counties, Ohio: U.S. Geological Survey Water-Resources Investigations, Report 98-??, ? pages. The report is in review, Sept, 1997. Nishikawa Tracy, K. S. Paybins, J. A. Izbicki, and E. G. Reichard, "Numerical

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Documentation	Jobson, H.E., 1989, Users manual for an open-channel streamflow model based on the diffusion analogy: U.S. Geological Survey Water-Resources Investigations 89-4133, 73 p.
Other Comments	
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